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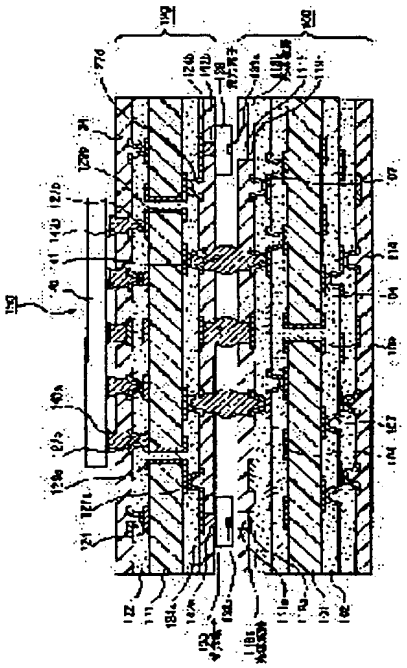
(54) DEVICE FOR OPTICAL COMMUNICATION

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a device for optical communication which has low connection loss between mounted optical components and has excellent connection reliability.
SOLUTION: In the device for optical communication consisting of a substrate for mounting an integrated circuit chip and a multilayer printed circuit board, a light receiving element and a light emitting element are mounted at the side of the board for mounting the integrated circuit chip opposed to the multilayer printed circuit board so that the light receiving part and the light emitting part are exposed, respectively. An optical waveguide is formed at the side of the multilayer printed circuit board opposed to the substrate for mounting the integrated circuit chip. An optical signal is transmitted through the optical waveguide and the light receiving element or the light emitting element.



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CLAIMS

[Claim(s)]
[Claim 1] It is the device for optical communication which consists of a substrate for IC chip mounting, and a multilayer printed wiring board. To said substrate for IC chip mounting A photo detector and a light emitting device are mounted so that a light sensing portion and a light-emitting part may be exposed to said multilayer printed wiring board and the side which counters, respectively. To said multilayer printed wiring board The device for optical communication characterized by being constituted so that optical waveguide may be formed in said substrate for IC chip mounting, and the side which counters and a lightwave signal can be transmitted through said optical waveguide, and said photo detector or said light emitting device.
[Claim 2] said substrate for IC chip mounting — a substrate top — a conductor — the conductor with which laminating formation was carried out and said substrate of the resin insulating layer [a circuit and] between layers was pinched — the conductor with which the through hole connected and circuits sandwiched said resin insulating layer between layers — the device for optical communication according to claim 1 to which circuits are connected by the Bahia hall.
[Claim 3] said multilayer printed wiring board — a substrate top — a conductor — the conductor with which laminating formation was carried out and said substrate of the resin insulating layer [a circuit and] between layers was pinched — the conductor with which the through hole connected and circuits sandwiched said resin insulating layer between layers — the device for optical communication according to claim 1 or 2 to which circuits are connected by the Bahia hall.
[Claim 4] Said substrate for IC chip mounting and said multilayer printed wiring board are a device for optical communication given in any 1 of claims 1-3 in which the solder bump is formed in order to transmit an electrical signal.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the device for optical communication.
[0002] In recent years, attentions have gathered for the optical fiber focusing on the communication link field. In especially IT (information technology) field, the communication technology which used the optical fiber for maintenance of the high-speed Internet network is needed. In the communication system using the optical fiber which has the descriptions, such as ** low loss, ** high bandwidth, ** narrow diameter and a light weight, no ** guiding, and ** saving resources, and has this description, compared with the communication system using the conventional metallic cable, the number of repeaters can be reduced sharply, construction and maintenance become easy, and an optical fiber can attain economization of communication system, and high-reliability-ization.
[0003] Moreover, since an optical fiber can multiplex the light of the wavelength from which not only the light of one wavelength but many differ to coincidence with one optical fiber, it can realize the transmission line of the large capacity which can respond to various applications, and can respond to image service etc.
[0004] Then, in network communication, such as such the Internet, using the optical communication using an optical fiber not only for the communication link of a backbone but for the communication link with a backbone and terminal equipments (a personal computer, mobile one, game, etc.) and the communication link of terminal equipments is proposed. Thus, when using optical communication for the communication link with a backbone and a terminal equipment etc., it is necessary to attach the device for optical communication in a terminal equipment, and what was equipped with optics which process the optical waveguide which transmits a lightwave signal to a substrate, and a lightwave signal, such as a photo detector and a light emitting device, as a device for optical communication is proposed.
[0005]
[Problem(s) to be Solved by the Invention] However, the conventional device for optical communication was not enough satisfactory in respect of connection dependability. This is considered to be because for the low connection loss in the factor for attaining the optical communication which is excellent in connection dependability, i.e., the connection between optics, (for example, connection with connection between an optical fiber and optical waveguide, optical waveguide and a photo detector, or a light emitting device) to fully have not been securable.
[0006]
[Means for Solving the Problem] Then, in order to secure low connection loss in connection between optics, as a result of inquiring wholeheartedly, in case this invention persons mounted an optic on a substrate and/or in a substrate, they hit on an idea for each optic to be mounted in a position, namely, for low connection loss to be secured by losing location gap of each optic, and completed the device for optical communication of this invention which consists of the following configuration.
[0007] The device for optical communication of this invention is a device for optical communication which consists of a substrate for IC chip mounting, and a multilayer printed wiring board. Namely, to the above-mentioned substrate for IC chip mounting A photo detector and a light emitting device are mounted so that a light sensing portion and a light-emitting part may be exposed to the above-mentioned multilayer printed wiring board and the side which counters, respectively. To the above-mentioned multilayer printed wiring board Optical waveguide is formed in the above-mentioned substrate for IC chip mounting, and the side which counters, and it is characterized by being constituted so that a lightwave signal can be transmitted through the above-mentioned optical waveguide, and the above-mentioned photo detector or the above-mentioned light emitting device.
[0008] In the device for optical communication of this invention moreover, the above-mentioned substrate for IC chip mounting Circuits are connected by the through hole. a substrate top — a conductor — the conductor with

which laminating formation was carried out and the above-mentioned substrate of the resin insulating layer [a circuit and] between layers was pinched — It is desirable for circuits to be connected by the Bahia hall. the conductor which sandwiched the above-mentioned resin insulating layer between layers — the above-mentioned multilayer printed wiring board a substrate top — a conductor — the conductor with which laminating formation was carried out and the above-mentioned substrate of the resin insulating layer [a circuit and] between layers was pinched — the conductor with which the through hole connected and circuits sandwiched the above-mentioned resin insulating layer between layers — it is desirable for circuits to be connected by the Bahia hall. Moreover, in the device for optical communication of this invention, in order to transmit an electrical signal, as for the above-mentioned substrate for IC chip mounting, and the above-mentioned multilayer printed wiring board, it is desirable to form the solder bump.

[0009]

[Embodiment of the Invention] Hereafter, the device for optical communication of this invention is explained. The device for optical communication of this invention is a device for optical communication which consists of a substrate for IC chip mounting, and a multilayer printed wiring board. To the above-mentioned substrate for IC chip mounting A photo detector and a light emitting device are mounted so that a light sensing portion and a light-emitting part may be exposed to the above-mentioned multilayer printed wiring board and the side which counters, respectively. To the above-mentioned multilayer printed wiring board Optical waveguide is formed in the above-mentioned substrate for IC chip mounting, and the side which counters, and it is characterized by being constituted so that a lightwave signal can be transmitted through the above-mentioned optical waveguide, and the above-mentioned photo detector or the above-mentioned light emitting device.

[0010] Since the device for optical communication of this invention consists of a substrate for IC chip mounting with which the photo detector and the light emitting device were mounted in the position, and a multilayer printed wiring board with which optical waveguide was formed in the position, its connection loss between the mounted optics is low, and excellent in connection dependability as a device for optical communication.

[0011] Moreover, in the device for optical communication of this invention, when coming to connect the above-mentioned substrate for IC chip mounting, and the above-mentioned multilayer printed wiring board through a solder bump, both can be more certainly stationed to a position according to the self-alignment operation which solder has. In addition, in order that, as for a self-alignment operation, a solder resist layer may crawl solder, solder says the operation to which it is going to exist in a stable configuration by near the center of opening for solder bump formation with the fluidity which self has at the time of reflow processing. Though location gap has occurred to both in front of a reflow in case the above-mentioned substrate for IC chip mounting is connected on the above-mentioned multilayer printed wiring board through the above-mentioned solder bump when this self-alignment operation is used, the above-mentioned substrate for IC chip mounting can move at the time of a reflow, and this substrate for IC chip mounting can be attached in the exact location on the above-mentioned multilayer printed wiring board. therefore, if it is alike, respectively and optics, such as a photo detector, a light emitting device, and optical waveguide, are attached in the exact location, the device for optical communication which is excellent in connection dependability can be manufactured by [of the above-mentioned substrate for IC chip mounting, and the above-mentioned multilayer printed wiring board] connecting the above-mentioned substrate for IC chip mounting on the above-mentioned multilayer printed wiring board through a solder bump.

[0012] The photo detector and the light emitting device are mounted so that a light sensing portion and a light-emitting part may expose the substrate for IC chip mounting which constitutes the above-mentioned device for optical communication to the above-mentioned multilayer printed wiring board and the side which counters, respectively. As the above-mentioned photo detector, PD (photodiode), APD (avalanche photodiode), etc. are mentioned, for example. What is necessary is just to use these properly suitably in consideration of the configuration of the above-mentioned device for optical communication, demand characteristics, etc. Si, germanium, InGaAs, etc. are mentioned as an ingredient of the above-mentioned photo detector. In these, a point to InGaAs which is excellent in light-receiving sensibility is desirable.

[0013] As the above-mentioned light emitting device, LD (semiconductor laser), DFB-LD (distribution feedback mold-semiconductor laser), LED (light emitting diode), etc. are mentioned, for example. What is necessary is just to use these properly suitably in consideration of a configuration, demand characteristics, etc. of the above-mentioned device for optical communication.

[0014] As an ingredient of the above-mentioned light emitting device, a gallium, arsenic and the compound (GaAsP) of Lynn, a gallium, aluminum and the compound (GaAlAs) of arsenic, a gallium and the compound (GaAs) of arsenic, an indium, a gallium and the compound (InGaAs) of arsenic, an indium, a gallium, arsenic, the compound (InGaAsP) of Lynn, etc. are mentioned. That what is necessary is just to use these properly in consideration of communication link wavelength, when communication link wavelength is 0.85-micrometer band, GaAlAs can be used, and in the case of 1.3-micrometer band or 1.55-micrometer band, communication link

wavelength can use InGaAs and InGaAsP. Moreover, as for the above-mentioned substrate for IC chip mounting, t is desirable to form the solder bump for transmitting an electrical signal. Thereby, it is because an electrical signal can be transmitted between external electronic parts.

[0015] Moreover, optical waveguide is formed in the side which the multilayer printed wiring board which constitutes the above-mentioned device for optical communication counters with the above-mentioned substrate for IC chip mounting. Therefore, a lightwave signal can be transmitted through optical waveguide.

[0016] As an ingredient of the above-mentioned optical waveguide, quartz glass, a compound semiconductor, a polymer ingredient, etc. are mentioned, for example. In these, while excelling in workability, it excels in adhesion with the resin insulating layer between layers of a multilayer printed wiring board, and the point which is low cost to a polymer is desirable.

[0017] As the above-mentioned polymer ingredient, a well-known thing can be used conventionally, and, specifically, the polymer manufactured from silicone resin; benz-cyclo-butene, such as polyimide resin; epoxy resin;UV hardenability epoxy resin; deuteration silicone resin, such as acrylic resin; fluorination polyimide, such as PMMA (polymethylmethacrylate), Deuteration PMMA, and heavy hydrogen fluorination PMMA, is mentioned.

[0018] Moreover, the thickness of the above-mentioned optical waveguide has desirable 5-50 micrometers, and the width of face has desirable 1-50 micrometers. In the above-mentioned multilayer printed wiring board, it is desirable for the optical waveguide formed in the location which counters the photo detector of the substrate for IC chip mounting, and the optical waveguide formed in the location which counters the light emitting device of the substrate for IC chip mounting to be what consists of the same ingredient. Moreover, it is desirable to form the optical-path conversion mirror in the above-mentioned optical waveguide. By forming an optical-path conversion mirror, it is because it is possible to change an optical path into a desired include angle. Formation of the above-mentioned optical-path conversion mirror can be performed by carrying out grinding of the end of optical waveguide so that it may mention later. Moreover, as for the above-mentioned multilayer printed wiring board, it is desirable to form the solder bump for transmitting an electrical signal. Thereby, it is because an electrical signal can be transmitted between external electronic parts.

[0019] Moreover, in the device for optical communication of this invention, the above-mentioned substrate for IC chip mounting and a multilayer printed wiring board are arranged so that the above-mentioned photo detector and the above-mentioned light emitting device, and the above-mentioned optical waveguide may counter, and they are constituted so that a lightwave signal can be transmitted through the above-mentioned photo detector or the above-mentioned light emitting device, and the above-mentioned optical waveguide.

[0020] Specifically, both can be stationed by connecting through a solder bump to the position which the above-mentioned photo detector and the above-mentioned light emitting device, and the above-mentioned optical waveguide counter. It is because a self-alignment operation of solder can be used.

[0021] An example of the operation gestalt of the device for optical communication which consists of the above-mentioned configuration hereafter is explained referring to a drawing. Drawing 1 is the sectional view showing typically 1 operation gestalt of the device for optical communication of this invention. In addition, the device for optical communication in the condition that IC chip was mounted is shown in drawing 1 .

[0022] As shown in drawing 1 , the device 150 for optical communication consists of the substrates 120 for IC chip mounting and multilayer printed wiring boards 100 which mounted the IC chip 140, and the substrate 120 for IC chip mounting and the multilayer printed wiring board 100 are electrically connected through the solder connection 141.

[0023] the mounting substrate 120 for IC chip — both sides of a substrate 121 — a conductor — the conductor with which laminating formation was carried out and the substrate 121 of the resin insulating layer [a circuit 124 (124a, 124b) and] 122 between layers was pinched — the conductor which sandwiched circuits and the resin insulating layer 122 between layers — circuits are electrically connected by the through hole 129 (129a, 129b) and the Bahia hall 127 (127a, 127b, 127c, 127d), respectively. Moreover, the solder resist layer 134 equipped with the solder bump is formed in the outermost layer of the mounting substrate 120 for IC chip, in addition the outermost layer of a multilayer printed wiring board 100 and the side which counters equips it with the photo detector 138 and the light emitting device 139 so that light sensing portion 138a and light-emitting part 139a may be exposed, respectively.

[0024] a multilayer printed wiring board 100 — both sides of a substrate 101 — a conductor — the conductor with which laminating formation was carried out and the substrate 101 of the resin insulating layer [a circuit 104 and] 102 between layers was pinched — the conductor which sandwiched circuits and the resin insulating layer 102 between layers — circuits are electrically connected by the through hole 109 and the Bahia hall 107, respectively. Moreover, while the solder resist layer 114 equipped with the opening 111 for optical paths and a solder bump is formed, the optical waveguide 118 (118a, 118b) equipped with the optical conversion mirror 119 (119a, 119b) directly under [for optical paths] opening 111 (111a, 111b) is formed in the mounting substrate

120 for IC chip of a multilayer printed wiring board 100, and the outermost layer of the side which counters.
[0025] In the device 150 for optical communication which consists of such a configuration The lightwave signal sent from the outside through an optical fiber (not shown) is introduced into optical waveguide 118a. After being sent to the photo detector 138 (light sensing portion 138a) through optical-path conversion mirror 119a and opening 111a for optical paths, it changes into an electrical signal by the photo detector 138 — having — further — conductive layer 142a- a conductor — it will be sent to the IC chip 140 through circuit 124a-Bahia hall 127a-through hole 129a-Bahia hall 127b-solder connection 143a.
[0026] Moreover, the electrical signal sent out from the IC chip 140 solder connection 143b-Bahia hall 127c-through hole 129b-Bahia hall 127d- a conductor, after being sent to a light emitting device 139 through circuit 124b-conductive layer 142b it changes into a lightwave signal by the light emitting device 139 — having — this lightwave signal — opening from light emitting device 139 (light-emitting part 139a) 111for optical paths b — and it conversion mirror [optical] 119b minds, is introduced into optical waveguide 118b, and is delivery outside as a lightwave signal through an optical fiber (not shown) further — it will be carried out.
[0027] In the device for optical communication of this invention, since light / electrical signal conversion is performed, the transmission distance of an electrical signal is short and can respond to a high-speed communication link more in the location near the inside of the substrate for IC chip mounting, i.e., IC chip. moreover, the electrical signal sent out from IC chip is delivery outside through an optical fiber, after being changed into a lightwave signal, as mentioned above — it is not only carried out, but it sends to a multilayer printed wiring board through a solder bump — having — the conductor of this multilayer printed wiring board — it will be sent to electronic parts, such as other IC chips mounted in the multilayer printed wiring board, through a circuit (the Bahia hall and a through hole are included).
[0028] Next, how to manufacture the device for optical communication of this invention is explained. the photo detector of the substrate for IC chip mounting after the above-mentioned device for optical communication manufactures separately for example, the substrate for IC chip mounting, and a multilayer printed wiring board and a light emitting device, and the conductor of a multilayer printed wiring board — both are stationed so that a circuit may counter, and further, solder bumps are connected by reflow processing, adjusting both location, and it manufactures by forming a solder connection. Therefore, suppose that the manufacture approach of the substrate for IC chip mounting and the manufacture approach of a multilayer printed wiring board are explained separately, and how to connect both is explained after that first here.
[0029] First, the manufacture approach of the substrate for IC chip mounting is explained.
(1) an insulating substrate — a start ingredient — carrying out — first — this insulating substrate top — a conductor — form a circuit. As the above-mentioned insulating substrate, a glass epoxy group plate, a polyester substrate, a polyimide substrate, a bismaleimide-triazine (BT) resin substrate, a thermosetting polyphenylene ether substrate, copper clad laminate, a RCC substrate, etc. are mentioned, for example. Moreover, ceramic substrates, such as an alumimium nitride substrate, and a silicon substrate may be used. the above — a conductor — a circuit can be formed by performing etching processing, after forming a solid conductor layer in the front face of for example, the above-mentioned insulating substrate by nonelectrolytic plating processing etc. Moreover, you may form by performing etching processing to copper clad laminate or a RCC substrate.
[0030] moreover, the conductor whose above-mentioned insulating substrate was pinched — in making connection between circuits by the through hole, after using a drill, laser, etc. for example, for the above-mentioned insulating substrate and forming a through tube, the through hole is formed by performing nonelectrolytic plating processing etc. In addition, the diameter of the above-mentioned through tube is usually 100-300 micrometers. Moreover, when a through hole is formed, it is desirable to be filled up with a resin filler in this through hole.
[0031] (2) next, the need — responding — a conductor — perform roughening formation processing on the surface of a circuit. as the above-mentioned roughening formation processing — melanism (oxidization) — the etching processing using the etching reagent containing - reduction processing, the second copper complex, and an organic-acid salt etc., processing by the Cu-nickel-P needlelike alloy plating, etc. can be mentioned. the case where a roughening side is formed here — the average roughness of this roughening side — usually — 0.1-5 micrometers — desirable — a conductor — the adhesion of a circuit and the resin insulating layer between layers, and a conductor — when the effect to the electrical signal transmission ability of a circuit etc. is taken into consideration, 2-4 micrometers is more desirable. In addition, before this roughening formation processing is filled up with a resin filler in a through hole, it may be performed, and it may form a roughening side also in the wall surface of a through hole. It is because the adhesion of a through hole and a resin filler improves.
[0032] (3) next, a conductor — form the resin layer which forms the resin layer which is not hardened [which some of thermosetting resin photopolymers, and thermosetting resin become from the acrylic-ized resin, these and thermoplastics, and the included resin complex] on the substrate in which the circuit was formed, or

consists of thermoplastics. The resin layer which is not hardened [above-mentioned] can be formed by applying non-hardened resin by the roll coater, a curtain coating machine, etc., or carrying out thermocompression bonding of the resin film non-hardened (semi-hardening). Moreover, the resin layer which consists of the above-mentioned thermoplastics can be formed by carrying out thermocompression bonding of the resin Plastic solid fabricated on the film.

[0033] In these, the approach of carrying out thermocompression bonding of the resin film non-hardened (semi-hardening) is desirable, and sticking by pressure of a resin film can be performed for example, using a vacuum laminator etc. Moreover, although what is necessary is not to limit especially sticking-by-pressure conditions, but just to choose suitably in consideration of the presentation of a resin film etc., it is usually desirable to carry out on a pressure 0.25 - 1.0MPa, the temperature of 40-70 degrees C, the degree of vacuum of 13-1300Pa, and about [time amount 10-120 second] conditions.

[0034] As the above-mentioned thermosetting resin, an epoxy resin, phenol resin, polyimide resin, polyester resin, a bismaleimide resin, polyolefine system resin, polyphenylene ether resin, polyphenylene resin, a fluororesin, etc. are mentioned, for example. As an example of the above-mentioned epoxy resin, novolak mold epoxy resins, such as a phenol novolak mold and a cresol novolak mold, the cycloaliphatic epoxy resin which carried out dicyclopentadiene conversion are mentioned, for example.

[0035] As the above-mentioned photopolymer, acrylic resin etc. is mentioned, for example. Moreover, the thing to which the heat-curing radical, and the methacrylic acid and acrylic acid of the above-mentioned thermosetting resin were made to acrylic--ization-react as resin which acrylic-ized some above-mentioned thermosetting resin for example, is mentioned.

[0036] As the above-mentioned thermoplastics, phenoxy resin, polyether sulfone (PES), polysulfone (PSF), polyphenylene sulfone (PPS) polyphenylene sulfide (PPES), polyphenylene ether (PPE) polyether imide (PI), etc. are mentioned, for example.

[0037] Moreover, as the above-mentioned resin complex, especially if thermosetting resin, a photopolymer (the resin which acrylic-ized some thermosetting resin is also included), and thermoplastics are included, it will not be limited, but as a concrete combination of thermosetting resin and thermoplastics, phenol resin / polyether sulfone, polyimide resin/polysulfone, an epoxy resin / polyether sulfone, an epoxy resin/phenoxy resin, etc. are mentioned, for example. Moreover, as a concrete combination of a photopolymer and thermoplastics, acrylic resin/phenoxy resin, the epoxy resin that acrylic-ized a part of epoxy group, polyether sulfone, etc. are mentioned, for example.

[0038] Moreover, as for the rate of a compounding ratio of thermosetting resin and the photopolymer in the above-mentioned resin complex, and thermoplastics, thermosetting resin or a photopolymer / thermoplastics =95 / 5 - 50/50 are desirable. It is because a high toughness value is securable, without spoiling thermal resistance.

[0039] Moreover, the above-mentioned resin layer may consist of resin layers from which it differs more than two-layer. It is that a lower layer is formed from thermosetting resin or the resin complex of a photopolymer / thermoplastics =50/50, and the upper layer is specifically formed from thermosetting resin or the resin complex of a photopolymer / thermoplastics =90/10 etc. While securing the outstanding adhesion with an insulating substrate by making it such a configuration, the formation ease at the time of forming opening for the Bahia halls etc. at a back process is securable.

[0040] Moreover, the above-mentioned resin layer may be formed using the resin constituent for roughening side formation. The matter of fusibility is distributed to the roughening liquid which consists of at least one sort chosen from an acid, alkali, and an oxidizer into the heat-resistant-resin matrix which is not hardened [poorly soluble] to the roughening liquid which serves as the above-mentioned resin constituent for roughening side formation from at least one sort chosen from an acid, alkali, and an oxidizer. In addition, when the same time amount immersion is carried out, the word of the above "poor solubility" and "fusibility" says relatively what has an early dissolution rate as "fusibility" to the same roughening liquid for convenience, and calls "poor solubility" relatively what has a late dissolution rate to it for convenience.

[0041] In case the above-mentioned roughening liquid is used for the resin insulating layer between layers and a roughening side is formed as the above-mentioned heat-resistant-resin matrix, what can hold the configuration of a roughening side is desirable, for example, thermosetting resin, thermoplastics, these complex, etc. are mentioned. Moreover, by using a photopolymer, exposure and a development may be used for the resin insulating layer between layers, and opening for the Bahia halls may be formed.

[0042] As the above-mentioned thermosetting resin, an epoxy resin, phenol resin, polyimide resin, polyolefin resin, a fluororesin, etc. are mentioned, for example. Moreover, when sensitization-izing the above-mentioned thermosetting resin, a heat-curing radical is made to acrylic(meta)--ization-react using a methacrylic acid, an acrylic acid, etc.

[0043] As the above-mentioned epoxy resin, a cresol novolak mold epoxy resin, the bisphenol A mold epoxy resin, a bisphenol female mold epoxy resin, a phenol novolak mold epoxy resin, an alkylphenol novolak mold epoxy resin, a biphenol female mold epoxy resin, a naphthalene mold epoxy resin, a dicyclopentadiene mold epoxy resin, the epoxidation object of the condensate of phenols and the aromatic aldehyde which has a phenolic hydroxyl group, triglycidyl isocyanurate, cycloaliphatic epoxy resin, etc. are mentioned, for example. These may be used independently and may be used together two or more sorts. Thereby, it excels in thermal resistance etc.
[0044] As the above-mentioned thermoplastics, phenoxy resin, polyether sulfone, polysulfone, polyphenylene sulfone, polyphenylene sulfide, a polyphenyl ether, polyether imide, etc. are mentioned, for example. These may be used independently and may be used together two or more sorts.
[0045] It is desirable that it is at least one sort as which the matter of fusibility is chosen from an inorganic particle, a resin particle, and metal particles to the roughening liquid which consists of at least one sort chosen from the above-mentioned acid, alkali, and an oxidizer.
[0046] As the above-mentioned inorganic particle, an aluminium compound, a lime compound, a potassium compound, a magnesium compound, a silicon compound, etc. are mentioned, for example. These may be used independently and may be used together two or more sorts.
[0047] As the above-mentioned aluminium compound, as the above-mentioned lime compound, a calcium carbonate, a calcium hydroxide, etc. are mentioned, potassium carbonate etc. is mentioned, an alumina, an aluminum hydroxide, etc. are mentioned and a silica, a zeolite, etc. are mentioned [a magnesia, a dolomite basic magnesium carbonate, talc, etc. are mentioned, and] as the above-mentioned silicon compound as the above-mentioned magnesium compound as the above-mentioned potassium compound, for example. These may be used independently and may be used together two or more sorts.
[0048] Dissolution removal of the above-mentioned alumina particle can be carried out by fluoric acid, and dissolution removal of the calcium carbonate can be carried out with a hydrochloric acid. Moreover, dissolution removal of a sodium content silica or the dolomite can be carried out in an alkali water solution.
[0049] As the above-mentioned resin particle, what consists of thermosetting resin, thermoplastics, etc. is mentioned, for example. When immersed in the roughening liquid which consists of at least one sort chosen from an acid, alkali, and an oxidizer It will not be limited especially if a dissolution rate is earlier than the above-mentioned heat-resistant-resin matrix. Specifically For example, amino resin (melamine resin, a urea-resin, guanamine resin, etc.), an epoxy resin, phenol resin, phenoxy resin, polyimide resin, polyphenylene resin, polyolefin resin, a fluororesin, bismaleimide-triazine resin, etc. are mentioned. These may be used independently and may be used together two or more sorts. In addition, the above-mentioned resin particle needs to carry out hardening processing beforehand. It is because the above-mentioned resin particle will dissolve in the solvent in which a resin matrix is dissolved if it is not made to harden.
[0050] Moreover, as the above-mentioned resin particle, a rubber particle, liquid phase resin, liquid phase rubber, etc. may be used. As the above-mentioned rubber particle, acrylonitrile-butadiene rubber, polychloroprene rubber, polyisoprene rubber, acrylic rubber, multi-** system rigidity rubber, a fluororubber, polyurethane rubber, silicone rubber, ABS plastics, etc. are mentioned, for example. Moreover, for example, various denaturation polybutadiene rubbers, such as polybutadiene rubber, epoxy denaturation, urethane denaturation, and acrylonitrile (meta) denaturation, the acrylonitrile-butadiene rubber (meta) containing a carboxyl group, etc. may be used.
[0051] As the above-mentioned liquid phase resin, the non-hardened solution of the above-mentioned thermosetting resin can be used, and epoxy non-hardened oligomer, the mixed liquor of an amine system curing agent, etc. are mentioned as an example of such liquid phase resin, for example. As the above-mentioned liquid phase rubber, non-hardened solutions, such as various denaturation polybutadiene rubbers, such as the above-mentioned polybutadiene rubber, epoxy denaturation, urethane denaturation, and acrylonitrile (meta) denaturation, and acrylonitrile-butadiene rubber (meta) containing a carboxyl group, etc. can be used, for example.
[0052] To prepare the above-mentioned photopolymer constituent using the above-mentioned liquid phase resin or liquid phase rubber, a heat-resistant-resin matrix and the matter of fusibility need to dissolve and twist to homogeneity (that is, phase separation is carried out like), and need to choose these matter like. By mixing the heat-resistant-resin matrix chosen by the above-mentioned criteria and the matter of fusibility, the photopolymer constituent in the condition that the "island" of a heat-resistant-resin matrix is distributing in the "sea" of the condition which the "island" of liquid phase resin or liquid phase rubber is distributing in the "sea" of the above-mentioned heat-resistant-resin matrix, liquid phase resin, or liquid phase rubber can be prepared. And after stiffening the photopolymer constituent of such a condition, a roughening side can be formed by removing the liquid phase resin or liquid phase rubber of the "sea" or a an "island."
[0053] As the above-mentioned metal particles, gold, silver, copper, tin, zinc, stainless steel, aluminum, nickel,

iron, lead, etc. are mentioned, for example. These may be used independently and may be used together two or more sorts. Moreover, the surface may be covered with resin etc. in order that the above-mentioned metal particles may secure insulation.

[0054] When two or more sorts are mixed and it uses the matter of the above-mentioned fusibility, as a combination of the matter of two sorts of fusibility to mix, the combination of a resin particle and an inorganic particle is desirable. the resin insulating layer between layers which adjustment of thermal expansion tends to plan them between poorly soluble resin, and they become from the resin constituent for roughening side formation while both of conductivity can be hurt low and can secure the insulation of the resin insulating layer between layers -- a crack -- not generating -- the resin insulating layer between layers, and a conductor -- it is because exfoliation does not occur between circuits.

[0055] It is desirable to use an organic acid in these as an acid used as the above-mentioned roughening liquid, for example, although organic acids, such as a phosphoric acid, a hydrochloric acid, a sulfuric acid, a nitric acid, and formic acid, an acetic acid, etc. are mentioned. It is because it is hard to make the metallic conductor layer exposed from the Bahia hall corrode when roughening processing is carried out. As the above-mentioned oxidizer, it is desirable to, use the water solution of a chromic acid, chromate acid mixture, and alkaline permanganates (potassium permanganate etc.) etc. for example. Moreover, as the above-mentioned alkali, water solutions, such as a sodium hydroxide and a potassium hydroxide, are desirable.

[0056] The mean particle diameter of the matter of the above-mentioned fusibility has desirable 10 micrometers or less. Moreover, big coarse grain and mean particle diameter may use it combining a small particle relatively relatively [mean particle diameter / the mean particle diameter of 2 micrometers or less]. That is, it is combining the matter of the fusibility whose mean particle diameter's is 0.1-0.5 micrometers, and the matter of the fusibility whose mean particle diameter's is 1-2 micrometers etc.

[0057] Thus, when big coarse grain and mean particle diameter combine a small particle relatively relatively [particle / average], the dissolution residue of the nonelectrolytic plating film can be lost, the amount of palladium catalysts under plating resist can be lessened, and a still shallower and complicated roughening side can be formed. Furthermore, by forming a complicated roughening side, even if the irregularity of a roughening side is small, the practical Peel reinforcement is maintainable. Mean particle diameter exceeds 0.8 micrometers, and that of the above-mentioned coarse grain is less than 2.0 micrometers, and, as for a particle, it is desirable for mean particle diameter to be 0.1-0.8 micrometers.

[0058] (4) Next, in forming the resin insulating layer between layers using thermosetting resin and resin complex as the ingredient, while performing hardening processing to a non-hardened resin insulating layer, form opening for the Bahia halls and consider as the resin insulating layer between layers. Moreover, at this process, a through tube may be formed if needed. As for the above-mentioned opening for the Bahia halls, forming by the lasing is desirable. Moreover, when a photopolymer is used as an ingredient of the resin insulating layer between layers, you may form by the exposure development.

[0059] Moreover, in forming the resin insulating layer between layers using thermoplastics as the ingredient, opening for the Bahia halls is formed in the resin layer which consists of thermoplastics, and it considers as the resin insulating layer between layers. In this case, opening for the Bahia halls can be formed by giving the lasing. Moreover, what is necessary is just to form this through tube by drilling, the lasing, etc., when forming a through tube at this process.

[0060] As laser used for the above-mentioned lasing, carbon dioxide gas laser, ultraviolet laser, excimer laser, etc. are mentioned, for example. In these, excimer laser and the carbon dioxide gas laser of a short pulse are desirable.

[0061] Moreover, it is desirable also in excimer laser to use the excimer laser of a hologram method. A hologram method is a method which irradiates a laser beam through a hologram, a condenser lens, a laser mask, an imprint lens, etc. at the specified substance, and much openings can be once formed in a resin film layer efficiently by exposure by using this method.

[0062] Moreover, when using carbon dioxide gas laser, as for the pulse separation, it is desirable that they are 10-4 - 10 to 8 seconds. Moreover, as for the time amount which irradiates the laser for forming opening, it is desirable that it is 10 - 500 microseconds. Moreover, much openings for the Bahia halls can be formed at once by irradiating a laser beam through an optical-system lens and a mask. By minding an optical-system lens and a mask, it is the same reinforcement and is because exposure reinforcement can irradiate the same laser beam at two or more parts. Thus, after forming opening for the Bahia halls, DESUMIA processing may be performed if needed.

[0063] (5) next, the front face of the resin insulating layer between layers including the wall of opening for the Bahia halls -- a conductor -- form a circuit. a conductor -- a circuit is formed -- if it hits, a thin film conductor layer is first formed in the front face of the resin insulating layer between layers. The above-mentioned thin film

conductor layer can be formed by approaches, such as nonelectrolytic plating and sputtering.
[0064] As the quality of the material of the above-mentioned thin film conductor layer, copper, nickel, tin, zinc, cobalt, a thallium, lead, etc. are mentioned, for example. In these, what consists of the copper from a point, copper, and nickel which are excellent in an electrical property, economical efficiency, etc. is desirable. Moreover, as thickness of the above-mentioned thin film conductor layer, when forming a thin film conductor layer with nonelectrolytic plating, 0.3-2.0 micrometers is desirable and 0.6-1.2 micrometers is more desirable. Moreover, when forming by sputtering, 0.1-1.0 micrometers is desirable.
[0065] Moreover, a roughening side may be formed in the front face of the resin insulating layer between layers before forming the above-mentioned thin film conductor layer. By forming a roughening side, the adhesion of the resin insulating layer between layers and a thin film conductor layer can be raised. When the resin insulating layer between layers is especially formed using the resin constituent for roughening side formation, it is desirable to form a roughening side using an acid, an oxidizer, etc.
[0066] Moreover, when a through tube is formed at the process of the above (4), in case a thin film conductor layer is formed on the resin insulating layer between layers, it is good also as a through hole by forming a thin film conductor layer also in the wall surface of a through tube.
[0067] (6) Subsequently, form plating resist on the substrate with which the thin film conductor layer was formed in the front face. After the above-mentioned plating resist sticks for example, a photosensitive dry film, it can carry out adhesion arrangement of the photo mask which consists of a glass substrate with which the plating resist pattern was drawn, and can form it by performing an exposure development.
[0068] (7) After that, perform electroplating by making a thin film conductor layer into a plating bar, and form an electroplating layer in the above-mentioned plating-resist agenesis section. As the above-mentioned electroplating, copper plating is desirable. Moreover, the thickness of the above-mentioned electroplating layer and 5-20 micrometers are desirable.
[0069] then, the thing for which the nonelectrolytic plating film and thin film conductor layer under the above-mentioned plating resist and this plating resist are removed — a conductor — a circuit (the Bahia hall is included) can be formed. What is necessary is just to perform removal of the above-mentioned thin film conductor layer using etching reagents, such as mixed liquor of a sulfuric acid and a hydrogen peroxide, sodium persulfate, ammonium persulfate, a ferric chloride, and a cupric chloride, that what is necessary is just to perform removal of the above-mentioned plating resist for example, using an alkali water solution etc. moreover, the above — a conductor — after forming a circuit, the catalyst on the resin insulating layer between layers may be removed using an acid or an oxidizer if needed. It is because the fall of an electrical property can be prevented. moreover, the method of performing etching processing, after replacing with the approach (a process (6) and (7)) of forming an electroplating layer after forming this plating resist and forming an electroplating layer the whole surface on a thin film conductor layer — using — a conductor — a circuit may be formed.
[0070] Moreover, when a through hole is formed in the above (4) and the process of (5), it may be filled up with a resin filler in this through hole. Moreover, when filled up with a resin filler in a through hole, a wrap lid plating layer may be formed for the surface section of a resin filler layer by performing nonelectrolytic plating if needed.
[0071] (8) next, the thing for which roughening processing is performed on the front face of this lid plating layer, and the process of (3) - (7) is further repeated if needed when a lid plating layer is formed — the both sides — the resin insulating layer between layers, and a conductor — carry out laminating formation of the circuit. In addition, a through hole may be formed and it is not necessary to form at this process.
[0072] (9) next, a conductor — form a solder resist layer in the outermost layer of the substrate in which the circuit and the resin insulating layer between layers were formed. The above-mentioned solder resist layer can be formed using the solder resist constituent which consists of for example, polyphenylene ether resin, polyolefin resin, a fluororesin, thermoplastic elastomer, an epoxy resin, polyimide resin, etc.
[0073] moreover, as solder resist constituents other than the above For example, the acrylate (meta) of a novolak mold epoxy resin, an imidazole curing agent, 2 functionality (meta) acrylic ester monomer, the polymer of with a molecular weight of about 500 to 5000 acrylic ester (meta), The fluid of the shape of a paste containing photosensitive monomers, such as thermosetting resin which consists of a bisphenol mold epoxy resin etc., and a multiple-valued acrylic monomer, a glycol ether system solvent, etc. is mentioned, and, as for the viscosity, it is desirable to be adjusted to 1 - 10 Pa-s at 25 degrees C.
[0074] (10) Next, form opening for solder bump formation, and opening for optical element mounting in the above-mentioned solder resist layer. Formation of the above-mentioned opening for solder bump formation can be performed using the approach of forming opening for the Bahia halls, and the same approach, i.e., an exposure development and the lasing. Moreover, in case a solder resist layer is formed, the solder resist layer which has opening for solder bump formation and opening for optical element mounting may be formed by producing the resin film which has opening in a desired location, and sticking this resin film on it beforehand.

[0075] (11) next, the conductor exposed by forming the above-mentioned opening for solder bump formation — f needed, a circuit part is covered with corrosion-resistant metals, such as nickel, palladium, gold, silver, and platinum, and let it be a solder pad. In these, it is desirable to form an enveloping layer with metals, such as nickel-gold, nickel-silver, nickel-palladium, and nickel-palladium-gold. Although the above-mentioned enveloping ayer can be formed according to plating, vacuum evaporationo, electrodeposition, etc., in these, it is desirable to form with plating from the point of excelling in the homogeneity of an enveloping layer. moreover, the conductor exposed by forming opening for optical element mounting at this process — it is desirable to form an enveloping ayer also in a circuit part.

[0076] (12) Next, form a solder bump by carrying out a reflow after filling up the above-mentioned solder pad with soldering paste through the mask with which opening was formed in the part equivalent to the above-mentioned solder pad.

[0077] (13) An optical element (a photo detector and light emitting device) is further mounted in a solder resist ayer. What is necessary is for mounting of an optical element to fill up soldering paste with the process of the above (12) also into opening for optical element mounting, and just to mount it through solder (conductive layer) further, by attaching the above-mentioned optical element, in case a reflow is performed. Moreover, it may replace with soldering paste and an optical element may be mounted using electroconductive glue etc. When these approaches are used, a photo detector and a light emitting device will be mounted in the front face of a solder resist layer.

[0078] Moreover, it may replace with the above-mentioned approach of carrying out a surface mount, in case opening for optical element mounting is formed at the process of the above (10), opening may be formed in the magnitude which can contain an optical element, and you may mount by containing an optical element in opening through electroconductive glue after that. In this case, a photo detector and a light emitting device will be built n a solder resist layer. By passing through such a process, the substrate for IC chip mounting which constitutes the device for optical communication of this invention can be manufactured.

[0079] Next, the manufacture approach of a multilayer printed wiring board is explained.

1) the first same process as (1) - (8) of the manufacture approach of the above-mentioned substrate for IC chip mounting — carrying out — the both sides — a conductor — a circuit and the resin insulating layer between layers produce the substrate by which laminating formation was carried out repeatedly. In addition, the through hole is suitably formed also at this process.

[0080] (2) next, the substrate for IC chip mounting and the conductor on the resin insulating layer between ayers of the side which counters — form optical waveguide in the circuit agenesis section. Formation of the above-mentioned optical waveguide can be performed by attaching beforehand the optical waveguide fabricated n the predetermined configuration through adhesives, when carrying out by using inorganic materials, such as quartz glass, for the ingredient. Moreover, the optical waveguide which consists of the above-mentioned norganic material can be formed by making the inorganic material of LiNbO3 and LiTaO3 grade form by the iquid-phase-epitaxial method, the chemistry depositing method (CVD), a molecular beam epitaxy, etc.

[0081] Moreover, when forming the above-mentioned optical waveguide using a polymer ingredient, the film for optical waveguide formation fabricated in the shape of a film on the substrate or the mold releasing film can be beforehand stuck on the resin insulating layer between layers, or optical waveguide can be formed from forming directly on the resin insulating layer between layers. Specifically, it can form using a selective polymerization method, the approach using reactive ion etching and photolithography, the direct exposing method, the approach using injection molding, the photograph breeching method, the approach that combined these. In addition, these approaches can be used also when forming directly it forms on the resin insulating layer between layers also when forming optical waveguide on a substrate or a mold releasing film.

[0082] Moreover, an optical-path conversion mirror is formed in the above-mentioned optical waveguide. Although you may form before attaching the above-mentioned optical-path conversion mirror on the resin insulating layer between layers, and you may form after attaching on the resin insulating layer between layers, it s desirable to form an optical-path conversion mirror beforehand except for the case where this optical waveguide is directly formed on the resin insulating layer between layers. other members which can work easily and constitute a multilayer printed wiring board at the time of an activity, for example, a conductor, — it is because a blemish is attached to a circuit, the resin insulating layer between layers, etc. or there is no possibility of damaging these.

[0083] It is not limited especially as an approach of forming the above-mentioned optical-path conversion mirror, but the well-known formation approach can be used conventionally. Specifically, machining with the diamond saw and cutter whose tip is 90 degrees of V types, processing by reactive ion etching, laser ablation, etc. can be used.

[0084] (3) Next, form a solder resist layer in the outermost layer of the substrate in which optical waveguide was

formed. The above-mentioned solder resist layer can be formed using the resin constituent used when forming the solder resist layer of for example, the above-mentioned substrate for IC chip mounting, and the same resin constituent.

[0085] (4) Next, form opening for solder bump formation, and opening for optical paths in the substrate for IC chip mounting, and the solder resist layer of the side which counters. Formation with the above-mentioned opening for solder bump formation and opening for optical paths can be performed to the substrate for IC chip mounting using the approach of forming opening for solder bump formation, and the same approach, i.e., an exposure development, the lasing, etc. In addition, formation of the above-mentioned opening for solder bump formation and formation of opening for optical paths may be performed to coincidence, and are separately good in a line.

[0086] In these, in case a solder resist layer is formed, it is desirable to choose the approach of forming opening for solder bump formation and opening for optical paths by applying the resin constituent which contains a photopolymer as the ingredient, and performing an exposure development. It is because there is no possibility of attaching a blemish to the optical waveguide which exists under this opening for optical paths, at the time of opening formation in forming opening for optical paths by the exposure development. Moreover, in case a solder resist layer is formed, the solder resist layer which has opening for solder bump formation and opening for optical paths may be formed by producing the resin film which has opening in a desired location, and sticking this resin film on it beforehand.

[0087] Moreover, opening for solder bump formation may be formed also in the solder resist layer of the substrate for IC chip mounting, the field which counters, and the opposite side if needed. By passing through a back process, it is because an external connection terminal can be formed also in the solder resist layer of the substrate for IC chip mounting, the field which counters, and the opposite side.

[0088] (5) next, the conductor exposed by forming the above-mentioned opening for solder bump formation — if needed, a circuit part is covered with corrosion-resistant metals, such as nickel, palladium, gold, silver, and platinum, and let it be a solder pad. What is necessary is just to specifically carry out to the substrate for IC chip mounting using the approach of forming a solder pad, and the same approach.

[0089] (6) Next, form a solder bump by carrying out a reflow after filling up the above-mentioned solder pad with soldering paste through the mask with which opening was formed in the part equivalent to the above-mentioned solder pad. Moreover, it is good also as PGA (Pin Grid Array) or BGA (Ball Grid Array) by arranging a pin in an external substrate connection side, or forming a solder ball in the solder resist layer of the substrate for IC chip mounting, the field which counters, and the opposite side. By passing through such a process, the multilayer printed wiring board which constitutes the device for optical communication of this invention can be manufactured.

[0090] Next, how to manufacture the device for optical communication is explained using the substrate for IC chip mounting and multilayer printed wiring board which were manufactured by the above-mentioned approach. First, a solder connection is formed by the solder bump of the above-mentioned substrate for IC chip mounting, and the solder bump of the above-mentioned multilayer printed wiring board, and both are connected electrically. That is, both are connected by carrying out opposite arrangement and carrying out a reflow of the substrate for IC chip mounting, and the multilayer printed wiring board to a position with the predetermined sense, respectively.

[0091] Moreover, in this process, even if some location gap exists among both when opposite arrangement of both is carried out in order to connect the substrate for IC chip mounting, and a multilayer printed wiring board using both solder bump, both can be stationed to a position by the self-alignment effectiveness by solder at the time of a reflow.

[0092] Next, IC chip is mounted in the above-mentioned substrate for IC chip mounting, and it considers as the device for optical communication by performing a resin seal after that if needed. Mounting of the above-mentioned IC chip can be conventionally performed by the well-known approach. Moreover, it is good also as a device for optical communication by connecting the substrate for IC chip mounting and multilayer printed wiring board which performed mounting of IC chip before connecting the substrate for IC chip mounting, and a multilayer printed wiring board, and mounted IC chip.

[0093]

[Example] Hereafter, this invention is further explained to a detail.

(Example 1)

A. The production bisphenol A mold epoxy resin (weight-per-epoxy-equivalent 469, Epicoat 1001 by oil-ized shell epoxy company) 30 weight section of the resin film for the resin insulating layers between production A-1. ayers of the substrate for IC chip mounting, The cresol novolak mold epoxy resin (weight-per-epoxy-equivalent 215, Epiclon N-673 by Dainippon Ink & Chemicals, Inc.) 40 weight section, The triazine structure content phenol

novolak resin (phenol nature hydroxyl equivalent 120, Dainippon Ink & Chemicals, Inc. make FENO light KA-7052) 30 weight section The ethyl diethylene glycol acetate 20 weight section, The heating dissolution is carried out stirring in the solvent naphtha 20 weight section. There The end epoxidation polybutadiene rubber (Nagase Brothers formation DENAREKKUSU R-45 by industrial company EPT) 15 weight section, and the 2-phenyl -4, the 5-screw (hydroxymethyl) imidazole grinding article 1.5 weight section, The pulverizing silica 2 weight section and the silicon system defoaming agent 0.5 weight section were added, and the epoxy resin constituent was prepared. After applying using a roll coater so that the thickness after drying the obtained epoxy resin constituent on a PET film with a thickness of 38 micrometers may be set to 50 micrometers, the resin film for the resin insulating layers between layers was produced by making it dry for 10 minutes at 80-120 degrees C.

[0094] The mean particle diameter by which coating of the silane coupling agent was carried out to the preparation bisphenol female mold epoxy monomer (oil-ized shell company make, molecular weight : 310 YL983U) 100 weight section of the resin constituent for through tube restoration and a front face A-2. By 1.6 micrometers the diameter of grain of maximum size — SiO2 spherical particle (the Adtec Corp. make —) 15 micrometers or less CRS The viscosity prepared the resin filler of 45 - 49 Pa-s at 23**1 degree C by carrying out stirring mixing of the 1101-CE170 weight section and the leveling agent (Sannopuko PERENORU S4) 1.5 weight section for a container. In addition, the imidazole curing agent (Shikoku formation shrine make, 2E4 MZ-CN) 6.5 weight section was used as a curing agent.

[0095] A-3. Copper clad laminate which 18-micrometer copper foil 28 laminates to both sides of the insulating substrate 21 which consists of the glass epoxy resin with a manufacture (1) thickness of 0.8mm or BT (bismaleimide triazine) resin of the substrate for IC chip mounting was used as the start ingredient (refer to drawing 2 (a)). first, the thing which drill drilling of this copper clad laminate is carried out, and nonelectrolytic plating processing is performed, and is etched in the shape of a pattern — both sides of a substrate 21 — a conductor — the circuit 24 and the through hole 29 were formed.

[0096] (2) Wash in cold water the substrate in which the circuit 24 was formed. a through hole 29 and a conductor — NaOH (10 g/l) after drying, and NaClO2 (40 g/l), Melanism processing the water solution containing Na3 PO4 (6 g/l) — melanism — it considers as a bath (oxidation bath) — and the conductor which performs reduction processing which makes a reduction bath NaOH (10 g/l) and the water solution containing NaBH4 (6 g/l), and includes a through hole 29 — the roughening sides 24a and 29a were formed in the front face of a circuit 24 (refer to drawing 2 (b)).

[0097] (3) the following approach after preparing the resin filler indicated to the above A-2 — after preparation — less than 24 hours — the conductor of one side of the inside of a through hole 29, and a substrate 21 — the circuit agenesis section and a conductor — the layer of resin filler 30' was formed in the rim section of a circuit 24. That is, after pushing in a resin filler in a through hole using a squeegee, it was made to dry on 100 degrees C and the conditions for 20 minutes first. next, a conductor — the conductor with which the part equivalent to the circuit agenesis section lays on a substrate the mask which carried out opening, and serves as a crevice using the squeegee — the circuit agenesis section was also filled up with the resin filler, and the layer of resin filler 30' was formed by making it dry on 100 degrees C and the conditions for 20 minutes (refer to drawing 2 (c)).

[0098] (4) the belt sander [one side / which finished processing of the above (3) / of a substrate] polish using the belt abrasive paper (Sankyo Rikagaku make) of **600 — a conductor — it ground so that resin filler 30' might remain neither in the front face of a circuit 24, nor the land front face of a through hole 29, and subsequently buffing for removing the blemish by the above-mentioned belt sander polish was performed. Such a series of polishes were similarly performed about the field of another side of a substrate. Subsequently, by 100 degrees C, it performed at 150 degrees C for 1 hour for 3 hours, 120 degrees C performed heat-treatment of 7 hours at 180 degrees C for 1 hour, and the resin filler layer 30 was formed.

[0099] thus, a through hole 29 and a conductor — the surface section of the resin filler 30 formed in the circuit agenesis section, and a conductor — the front face of a circuit 24 — flattening — carrying out — the resin filler 30 and a conductor — the insulating substrate which side-face 24a of a circuit 24 stuck firmly through the roughening side, and internal-surface 29a of a through hole 29 and the resin filler 30 stuck firmly through the roughening side was obtained (refer to drawing 2 (d)). this process — the front face of the resin filler layer 30, and a conductor — the front face of a circuit 24 turns into the same flat surface.

[0100] (5) software etching after rinsing and carrying out acid cleaning of the above-mentioned substrate — carrying out — subsequently — an etching reagent — both sides of a substrate — a spray — spraying — a conductor — etching the front face of a circuit 24, the land front face of a through hole 29, and a wall — a conductor — the roughening sides 24a and 29a were formed in all the front faces of a circuit 24 (refer to drawing 3 (a)). As an etching reagent, the etching reagent (the product made from MEKKU, MEKKU dirty bond) containing the imidazole copper (II) complex 10 weight section, the glycolic-acid 7 weight section, and the

potassium chloride 5 weight section was used.
[0101] (6) Next, the somewhat larger resin film for the resin insulating layers between layers than the substrate produced by the above A-1 was laid on the substrate, and after carrying out temporary sticking by pressure and judging on pressure 0.4MPa, the temperature of 80 degrees C, and the conditions for sticking-by-pressure time amount 10 seconds, the resin insulating layer 22 between layers was formed by sticking using vacuum laminator equipment by the approach of further the following (refer to drawing 3 (b)). That is, on the substrate, actual sticking by pressure was carried out on the degree of vacuum of 65Pa, pressure 0.4MPa, temperature 80, and the conditions for time amount 60 seconds, and heat curing of the resin film for the resin insulating layers between layers was carried out for 30 minutes at 170 degrees C after that.
[0102] (7) Next, mind the mask with which the through tube with a thickness of 1.2mm was formed on the resin insulating layer 22 between layers, and it is CO2 with a wavelength of 10.4 micrometers. By gas laser, the opening 26 for the Bahia halls with a diameter of 80 micrometers was formed in the resin insulating layer 22 between layers on the beam diameter of 4.0mm, the Top Hat mode, 8.0 microseconds of pulse width, the path of 1.0mm of the through tube of a mask, and the conditions of one shot (refer to drawing 3 (c)).
[0103] (8) The roughening side was formed in the front face containing the internal surface of the opening 26 for the Bahia halls by immersing the substrate in which the opening 26 for the Bahia halls was formed, for 10 minutes in the 80-degree C solution containing the permanganic acid of 60 g/l, and carrying out dissolution removal of the epoxy resin particle which exists in the front face of the resin insulating layer 22 between layers (refer to drawing 3 (d)).
[0104] (9) Next, the substrate which finished the above-mentioned processing was washed in cold water after being immersed in the neutralization solution (product made from SHIPUREI). Furthermore, the catalyst nucleus was made for the front face of this substrate that carried out the surface roughening process (a roughening depth of 3 micrometers) to adhere to the front face (for the internal surface of the opening 26 for the Bahia halls to be included) of the resin insulating layer 22 between layers by giving a palladium catalyst (not shown). That is, the above-mentioned substrate was immersed into the catalytic liquid containing a palladium chloride (PdCl2) and a stannous chloride (SnCl2), and the catalyst was given by depositing a palladium metal.
[0105] (10) Next, into the non-electrolytic copper plating water solution of the following presentations, the substrate was immersed and the non-electrolytic copper plating film 32 with a thickness of 0.6-3.0 micrometers was formed at the front face (the internal surface of the opening 26 for the Bahia halls is included) of the resin insulating layer 22 between layers, and the wall surface of a through tube 29 (refer to drawing 4 (a)).
[0106] [Nonelectrolytic plating water solution]
NiSO4 0.003 mol/l tartaric acid 0.200 mol/l copper sulfate 0.030 mol/lHCHO 0.050 mol/lNaOH 0.100 mol/lalpha and alpha'-bipyridyl 100 mg/l polyethylene glycol (PEG) 0.10 g/l [nonelectrolytic plating conditions]
It is 40 minutes [0107] by whenever [30-degree C solution temperature]. (11) Next, stick a commercial photosensitive dry film on the substrate with which the non-electrolytic copper plating film 32 was formed, lay a mask, and it is 100 mJ/cm2. The plating resist 23 with a thickness of 20 micrometers was formed by exposing and carrying out a development in a sodium-carbonate water solution 0.8% (refer to drawing 4 (b)).
[0108] (12) Subsequently, 50-degree C water washed the substrate and it degreased, with 25-degree C water, after washing with the sulfuric acid further after rinsing, electrolysis plating was performed on condition that the following, and the electrolytic copper plating film 33 with a thickness of 20 micrometers was formed in the plating-resist 23 agenesis section (refer to drawing 4 (c)).
[0109] [Electrolysis plating liquid]
Sulfuric acid 2.24 mol/l copper sulfate 0.26 mol/l additive 19.5 ml/l (made in ATOTEKKU Japan, KAPARASHIDO GL)
[Electrolysis plating conditions]
Current density 1 A/dm 2 hours 65 Part temperature 22**2 ** [0110] (13) -- a conductor with a thickness of 18 micrometers which carries out etching processing of the nonelectrolytic plating film under the plating resist 23 with the mixed liquor of a sulfuric acid and a hydrogen peroxide, carries out dissolution removal and consists of non-electrolytic copper plating film 32 and electrolytic copper plating film 33 further after carrying out exfoliation removal of the plating resist 23 by NaOH 5% -- the circuit 25 (the Bahia hall 27 is included) was formed (refer to drawing 4 (d)). furthermore, the etching reagent used at the process of the above (5) and the same etching reagent (MEKKU dirty bond) -- using -- a conductor -- the roughening side was formed in circuit 25 (the Bahia hall 27 is included) front face.
[0111] (14) Next, made it dissolve so that it may become 60% of the weight of concentration to diethylene-glycol wood ether (DMDG). The oligomer (molecular weight: 4000) 46.67 weight section of the photosensitive grant which acrylic-ized 50% of epoxy groups of a cresol novolak mold epoxy resin (Nippon Kayaku Co., Ltd. make), 80% of the weight of the bisphenol A mold epoxy resin (oil-ized shell company make --) dissolved in the methyl ethyl

ketone trade name: — the Epicoat 1001 15.0 weight section and an imidazole curing agent (Shikoku — formation — shrine make —) trade name: — 2 organic-functions acrylic monomer (the Nippon Kayaku Co., Ltd. make —) which are the 2E4 MZ-CN1.6 weight section and a photosensitive monomer trade name: — the R604 4.5 weight section — the same — a multiple-valued acrylic monomer (the Kyoei Kagaku K.K. make —) trade name: — the DPE6A1.5 weight section and a dispersed system defoaming agent (the Sannopuko make —) Stir the S-65 0.71 weight section for a container, mix, and a mixed constituent is prepared. The solder resist constituent which adjusted viscosity to 2.0 Pa-s at 25 degrees C was obtained by adding the benzophenone (Kanto chemistry company make) 2.0 weight section and the Michler's-ketone (Kanto chemistry company make) 0.2 weight section as a photosensitizer as a photopolymerization initiator to this mixed constituent. In addition, in the case of 60min-1 (rpm), in the case of rotor No.4 and 6min-1 (rpm), measurement of viscosity was based on rotor No.3 by the Brookfield viscometer (the Tokyo Keiki Co., Ltd. make, DVL-B mold).

[0112] (15) next, the resin insulating layer 22 between layers and a conductor — the above-mentioned solder resist constituent was applied by the thickness of 30 micrometers, for 20 minutes was performed at 70 degrees C, desiccation processing was performed to both sides of the substrate in which the circuit 25 (the Bahia hall 27 is included) was formed, the condition for 30 minutes at 70 degrees C, and layer 34' of a solder REJISU constituent was formed in them (refer to drawing 5 (a)).

[0113] (16) Subsequently, stick the photo mask with a thickness of 5mm with which the pattern of opening for solder bump formation and opening for optical elements (a photo detector and light emitting device) was drawn in a solder resist layer, and they are 1000 mJ/cm2. It exposed by ultraviolet rays, the development was carried out with the DMTG solution, and opening with a diameter of 200 micrometers was formed. And further, it carries out at 120 degrees C for 1 hour for 1 hour, heat-treats [80 degrees C / 1 hour and 100 degrees C] on the conditions of 3 hours by 150 degrees C, respectively, a solder resist layer is stiffened, it has the opening 35 for solder bump formation, and the opening 31 for optical elements, and the solder resist layer 34 the thickness of whose is 20 micrometers was formed (refer to drawing 5 (b)). In addition, a commercial solder resist constituent can also be used as the above-mentioned solder resist constituent.

[0114] (17) Next, the substrate in which the solder resist layer 34 was formed was immersed in the non-electrolyzed nickel-plating liquid of pH=4.5 containing a nickel chloride (2.3x10-1 mol/l), sodium hypophosphite (2.8x10-1 mol/l), and a sodium citrate (1.6x10-1 mol/l) for 20 minutes, and the nickel-plating layer with a thickness of 5 micrometers was formed in the opening 35 for solder bump formation, and the opening 31 for optical elements. Furthermore, the substrate was immersed in the non-electrolyzed gilding liquid containing a gold cyanide potassium (7.6x10-3 mol/l), an ammonium chloride (1.9x10 to 1 mol/l.), a sodium citrate (1.2x10-1 mol/l), and sodium hypophosphite (1.7x10-1 mol/l) for 7.5 minutes on 80-degree C conditions, the gilding layer with a thickness of 0.03 micrometers was formed on the nickel-plating layer, and it considered as the solder pad 36.

[0115] (18) Next, print soldering paste to the opening 35 for solder bump formation and the opening 31 for optical elements which were formed in the solder resist layer 34. Furthermore, by attaching in the soldering paste printed to the opening 31 for optical elements, performing alignment of light sensing portion 38a of a photo detector 38 and a light emitting device 39, and light-emitting part 39a, and carrying out a reflow to it at 200 degrees C While mounting the photo detector 38 and the light emitting device 39, the solder bump 37 was formed in the opening 35 for solder bump formation, and it considered as the substrate for IC chip mounting. In addition, as a photo detector 38, what consists of InGaAsP was used as a light emitting device 39 using what consists of InGaAs (refer to drawing 5 (c)).

[0116] B. The resin film for the resin insulating layers between layers was produced using the approach used by the production A-1 of the resin film for the resin insulating layers between production B-1. layers of a multilayer printed wiring board, and the same approach.

B-2. The resin constituent for through tube restoration was produced using the approach used by the preparation A-2 of the resin constituent for through tube restoration, and the same approach.

[0117] B-3. Copper clad laminate which 18-micrometer copper foil 8 laminates to both sides of the insulating substrate 1 which consists of the glass epoxy resin with a manufacture (1) thickness of 0.6mm or BT resin of a multilayer printed wiring board was used as the start ingredient (refer to drawing 6 R> 6 (a)). first, the thing which drill drilling of this copper clad laminate is carried out, and nonelectrolytic plating processing is performed, and is etched in the shape of a pattern — both sides of a substrate 1 — a conductor — the circuit 4 and the through hole 9 were formed.

[0118] (2) a through hole 29 and a conductor — the conductor which washes in cold water the substrate in which the circuit 24 was formed, sprays an etching reagent (the product made from MEKKU, MEKKU dirty bond) by the spray, and includes a through hole 9 after drying — the roughening sides 4a and 9a were formed in the front face of a circuit 4 (refer to drawing 6 (b)).

[0119] (3) the following approach after preparing the resin filler indicated to the above B-2 — after preparation — less than 24 hours — the conductor of one side of the inside of a through hole 9, and a substrate 1 — the circuit agenesis section and a conductor — the layer of resin filler 10' was formed in the rim section of a circuit 4. That is, after pushing in a resin filler in a through hole using a squeegee, it was made to dry on 100 degrees C and the conditions for 20 minutes first. next, a conductor — the conductor with which the part equivalent to the circuit agenesis section lays on a substrate the mask which carried out opening, and serves as a crevice using the squeegee — the circuit agenesis section was also filled up with the resin filler, and the layer of resin filler 10' was formed by making it dry on 100 degrees C and the conditions for 20 minutes (refer to drawing 6 (c)).
[0120] (4) the belt sander [one side / which finished processing of the above (3) / of a substrate] polish using the belt abrasive paper (Sankyo Rikagaku make) of **600 — a conductor — it ground so that resin filler 10' might remain neither in the front face of a circuit 4, nor the land front face of a through hole 9, and subsequently buffing for removing the blemish by the above-mentioned belt sander polish was performed. Such a series of polishes were similarly performed about the field of another side of a substrate. Subsequently, by 100 degrees C, it performed at 150 degrees C for 1 hour for 3 hours, 120 degrees C performed heat-treatment of 7 hours at 180 degrees C for 1 hour, and the resin filler layer 10 was formed.
[0121] thus, a through hole 9 and a conductor — the surface section of the resin filler 10 formed in the circuit agenesis section, and a conductor — the front face of a circuit 4 — flattening — carrying out — the resin filler 10 and a conductor — the insulating substrate which side-face 4a of a circuit 4 stuck firmly through the roughening side, and internal-surface 9a of a through hole 9 and the resin filler 10 stuck firmly through the roughening side was obtained (refer to drawing 6 (d)). this process — the front face of the resin filler layer 10, and a conductor — the front face of a circuit 4 turns into the same flat surface.
[0122] (5) software etching after rinsing and carrying out acid cleaning of the above-mentioned substrate — carrying out — subsequently — an etching reagent — both sides of a substrate — a spray — spraying — a conductor — etching the front face of a circuit 4, the land front face of a through hole 9, and a wall — a conductor — the roughening sides 4a and 9a were formed in all the front faces of a circuit 4 (refer to drawing 7 (a)). In addition, as an etching reagent, the product made from MEKKU and MEKKU dirty bond were used.
[0123] (6) Next, the somewhat larger resin film for the resin insulating layers between layers than the substrate produced by the above B-1 was laid on the substrate, and after carrying out temporary sticking by pressure and judging on pressure 0.4MPa, the temperature of 80 degrees C, and the conditions for sticking-by-pressure time amount 10 seconds, the resin insulating layer 2 between layers was formed by sticking using vacuum laminator equipment by the approach of further the following (refer to drawing 7 (b)). That is, on the substrate, actual sticking by pressure was carried out on the degree of vacuum of 65Pa, pressure 0.4MPa, temperature 80, and the conditions for time amount 60 seconds, and heat curing of the resin film for the resin insulating layers between layers was carried out for 30 minutes at 170 degrees C after that.
[0124] (7) Next, mind the mask with which the through tube with a thickness of 1.2mm was formed on the resin insulating layer 2 between layers, and it is CO2 with a wavelength of 10.4 micrometers. By gas laser, the opening 6 for the Bahia halls with a diameter of 80 micrometers was formed in the resin insulating layer 2 between layers on the beam diameter of 4.0mm, the Top Hat mode, 8.0 microseconds of pulse width, the path of 1.0mm of the through tube of a mask, and the conditions of one shot (refer to drawing 7 (c)).
[0125] (8) Next, plasma treatment was performed using Japanese vacuum-technology company make and SV-4540, and the front face of the resin insulating layer 2 between layers was roughened (refer to drawing 7 (d)). Here, argon gas was used as inert gas and plasma treatment was performed for 2 minutes on power 200W, 0.6Pa of gas pressure, and conditions with a temperature of 70 degrees C. Next, after exchanging internal argon gas using the same equipment, sputtering which targeted nickel was performed using SV-4540 the condition for [atmospheric-pressure / of 0.6Pa /, temperature / of 80 degrees C /, power 200W, and time amount] 5 minutes, and the metal layer which consists of nickel was formed in the front face of the resin insulating layer 2 between layers. In addition, the thickness of nickel layer is 0.1 micrometers.
[0126] (9) Next, the substrate in which nickel layer was formed into the non-electrolytic copper plating water solution of the following presentations was immersed, and the non-electrolytic copper plating film with a thickness of 0.6-3.0 micrometers was formed on nickel layer (refer to drawing 8 (a)). In addition, in drawing 8 , the layer which consists of a nickel layer and non-electrolytic copper plating film is indicated to be the thin film conductor layer 12.
[Nonelectrolytic plating water solution]
NiSO4 0.003 mol/l tartaric acid 0.200 mol/l copper sulfate 0.030 mol/lHCHO 0.050 mol/lNaOH 0.100 mol/lalpha and alpha'-bipyridyl 100 mg/l polyethylene glycol (PEG) 0.10 g/l [nonelectrolytic plating conditions]
It is 40 minutes [0127] by whenever [30-degree C solution temperature]. (10) Next, stick a commercial photosensitive dry film on the substrate with which the thin film conductor layer 12 was formed, lay a mask, and

it is 100 mJ/cm2. The plating resist 3 with a thickness of 20 micrometers was formed by exposing and carrying out a development in a sodium-carbonate water solution 0.8% (refer to drawing 8 (b)).
[0128] (11) Subsequently, 50-degree C water washed the substrate and it degreased, with 25-degree C water, after washing with the sulfuric acid further after rinsing, electrolysis plating was performed on condition that the following, and the electrolytic copper plating film 3 with a thickness of 20 micrometers was formed in the plating-resist 3 agenesis section (refer to drawing 8 (c)).
[Electrolysis plating liquid]
Sulfuric acid 2.24 mol/l copper sulfate 0.26 mol/l additive 19.5 ml/l (made in ATOTEKKU Japan, KAPARASHIDO GL)
[Electrolysis plating conditions]
Current density 1 A/dm 2 hours 65 Part temperature 22**2 ** [0129] (12) — a conductor with a thickness of 18 micrometers which carries out etching processing of the thin film conductor layer under the plating resist 3 with mixed liquor with a nitric acid, a sulfuric acid, and a hydrogen peroxide, carries out dissolution removal and consists of a thin film conductor layer 12 and electrolytic copper plating film 13 further after carrying out exfoliation removal of the plating resist 23 by NaOH 5% — the circuit 5 (the Bahia hall 7 is included) was formed (refer to drawing 8 (d)).
[0130] (13) next, the thing for which the process of the process of above-mentioned (5) - (12) is repeated — the upper resin insulating layer between layers, and a conductor — laminating formation of the circuit was carried out (refer to drawing 9 (a) - drawing 10 (a)). furthermore, the approach used at the process of the above (5) and the same approach — using — the conductor of the outermost layer — the roughening side was formed in the circuit.
[0131] (14) Next, the optical waveguide 18 which uses the following approaches for the position of the front face of the resin insulating layer 2 between layers of the outermost layer, and has the optical-path conversion mirror 19 was formed (refer to drawing 10 (b)). That is, beforehand, the optical waveguide (micro parts company make : 20 micrometers in width of face of 1mm, thickness) of the shape of a film which consists of PMMA by which the tip formed 45-degree optical-path conversion mirror 19 in the end using the diamond saw which is 90 degrees of V types was stuck so that the side face of the other end by the side of optical conversion mirror agenesis and the side face of the resin insulating layer between layers might gather. In addition, attachment of optical waveguide applies to 10 micrometers in thickness the adhesives which become an adhesion side with the resin insulating layer between layers of this optical waveguide from thermosetting resin, and was performed after sticking by pressure by making it harden at 60 degrees C for 1 hour. In addition, in this example, although hardened on the conditions of 60 degrees C / 1 hour, step hardening may be performed depending on the case. It is because it is hard to generate stress by optical waveguide at the time of attachment.
[0132] (15) Next, made it dissolve so that it may become 60% of the weight of concentration to diethylene-glycol wood ether (DMDG). The oligomer (molecular weight: 4000) 46.67 weight section of the photosensitive grant which acrylic-ized 50% of epoxy groups of a cresol novolak mold epoxy resin (Nippon Kayaku Co., Ltd. make), 80% of the weight of the bisphenol A mold epoxy resin (oil-ized shell company make —) dissolved in the methyl ethyl ketone trade name: — the Epicoat 1001 15.0 weight section and an imidazole curing agent (Shikoku — formation — shrine make —) trade name: — 2 organic-functions acrylic monomer (the Nippon Kayaku Co., Ltd. make —) which are the 2E4 MZ-CN1.6 weight section and a photosensitive monomer trade name: — the R604 3.0 weight section — the same — a multiple-valued acrylic monomer (the Kyoei Kagaku K.K. make —) trade name: — the DPE6A1.5 weight section and a dispersed system defoaming agent (the Sannopuko make —) Stir the S-65 0.71 weight section for a container, mix, and a mixed constituent is prepared. By adding the benzophenone (Kanto chemistry company make) 2.0 weight section and the Michler's-ketone (Kanto chemistry company make) 0.2 weight section as a photosensitizer as a photopolymerization initiator to this mixed constituent The solder resist constituent which adjusted viscosity to 2.0 Pa-s at 25 degrees C is prepared. Furthermore, the above-mentioned solder resist constituent was applied by the thickness of 35 micrometers, for 20 minutes was performed at 70 degrees C, desiccation processing was performed to both sides of the substrate in which optical waveguide 18 was formed, the condition for 30 minutes at 70 degrees C, and layer 14' of a solder REJISU constituent was formed in them (refer to drawing 10 (c)).
[0133] (16) Subsequently, make a solder resist layer stick the photo mask with a thickness of 5mm with which the pattern of opening for solder bump formation and opening for optical paths was drawn to one side of a substrate, and they are 1000 mJ/cm2. It exposed by ultraviolet rays, the development was carried out with the DMTG solution, and opening with a diameter of 200 micrometers was formed. And further, it carries out at 120 degrees C for 1 hour for 1 hour, heat-treats [80 degrees C / 1 hour and 100 degrees C] on the conditions of 3 hours by 150 degrees C, respectively, a solder resist layer is stiffened, it has the opening 15 for solder bump formation, and the opening 11 for optical elements, and the solder resist layer 14 the thickness of whose is 20

micrometers was formed (refer to drawing 11 (a)).
[0134] (17) Next, the substrate in which the solder resist layer 14 was formed was immersed in the non-electrolyzed nickel-plating liquid of pH=4.5 containing a nickel chloride (2.3x10-1 mol/l), sodium hypophosphite (2.8x10-1 mol/l), and a sodium citrate (1.6x10-1 mol/l) for 20 minutes, and the nickel-plating layer with a thickness of 5 micrometers was formed in the opening 15 for solder bump formation. Furthermore, the substrate was immersed in the non-electrolyzed gilding liquid containing a gold cyanide potassium (7.6x10-3 mol/l), an ammonium chloride (1.9x10 to 1 mol/l.), a sodium citrate (1.2x10-1 mol/l), and sodium hypophosphite (1.7x10-1 mol/l) for 7.5 minutes on 80-degree C conditions, the gilding layer with a thickness of 0.03 micrometers was formed on the nickel-plating layer, and it considered as the solder pad 16.
[0135] (18) Next, soldering paste was printed to the opening 15 for solder bump formation formed in the solder resist layer 14, and by carrying out a reflow at 200 degrees C, the solder bump 17 was formed in the opening 15 for solder bump formation, and it considered as the multilayer printed wiring board (refer to drawing 11 (b)).
[0136] C. IC chip was mounted in the substrate for IC chip mounting manufactured through manufacture **** of the device for IC mounting optical communication, and the process of Above A, the resin seal was performed after that, and IC mounting substrate was obtained. . Next, by making a position carry out opposite arrangement and carrying out a reflow of this IC chip mounting substrate and the multilayer printed wiring board manufactured through the process of Above B to it at 200 degrees C, the solder bumps of both substrates were connected, the solder connection was formed, and the device for IC mounting optical communication was manufactured (refer to drawing 1).
[0137] Thus, about the obtained device for IC mounting optical communication, an optical fiber is attached in an exposure from the multilayer printed wiring board of the optical waveguide which counters a photo detector. After attaching a detector in an exposure from the multilayer printed wiring board of the optical waveguide which counters a photo detector, The place which detected the lightwave signal with the detector after making a lightwave signal calculate with delivery and IC chip through an optical fiber, The desired lightwave signal could be detected and the device for IC mounting optical communication manufactured by this example became clear [having the engine performance which can be enough satisfied as a device for optical communication].
[0138]
[Effect of the Invention] Since the device for optical communication of this invention consists of a substrate for IC chip mounting with which the photo detector and the light emitting device were mounted in the position, and a multilayer printed wiring board with which optical waveguide was formed in the position as described above, its connection loss between the mounted optics is low, and excellent in connection dependability as a device for optical communication.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional view showing typically 1 operation gestalt of the device for optical communication of this invention.
[Drawing 2] It is the sectional view showing typically a part of process which manufactures the substrate for IC chip mounting which constitutes the device for optical communication of this invention.
[Drawing 3] It is the sectional view showing typically a part of process which manufactures the substrate for IC chip mounting which constitutes the device for optical communication of this invention.
[Drawing 4] It is the sectional view showing typically a part of process which manufactures the substrate for IC chip mounting which constitutes the device for optical communication of this invention.
[Drawing 5] It is the sectional view showing typically a part of process which manufactures the substrate for IC chip mounting which constitutes the device for optical communication of this invention.
[Drawing 6] It is the sectional view showing typically a part of process which manufactures the multilayer printed wiring board which constitutes the device for optical communication of this invention.
[Drawing 7] It is the sectional view showing typically a part of process which manufactures the multilayer printed wiring board which constitutes the device for optical communication of this invention.
[Drawing 8] It is the sectional view showing typically a part of process which manufactures the multilayer printed wiring board which constitutes the device for optical communication of this invention.
[Drawing 9] It is the sectional view showing typically a part of process which manufactures the multilayer printed wiring board which constitutes the device for optical communication of this invention.
[Drawing 10] It is the sectional view showing typically a part of process which manufactures the multilayer printed wiring board which constitutes the device for optical communication of this invention.
[Drawing 11] It is the sectional view showing typically a part of process which manufactures the multilayer printed wiring board which constitutes the device for optical communication of this invention.
[Description of Notations]
100 Multilayer Printed Wiring Board
101 Substrate
102 Resin Insulating Layer between Layers
104 Conductor — Circuit
107 Bahia Hall
109 Through Hole
111 Opening for Optical Paths
114 Solder Resist Layer
118 Optical Waveguide
119 Mirror for Optical Conversion
120 Substrate for IC Chip Mounting
121 Substrate
122 Resin Insulating Layer between Layers
124 Conductor — Circuit
127 Bahia Hall
129 Through Hole
131 Opening for Optical Elements
134 Solder Resist Layer
138 Photo Detector
139 Light Emitting Device
140 IC Chip

141 143 Solder connection
142 Conductive Layer
150 Device for Optical Communication

[Translation done.]